

Novel Hybrid Propulsion System for Sample Return Missions, Phase II



Completed Technology Project (2017 - 2020)

Project Introduction

Parabilis Space Technologies is pleased to propose continued development of an innovative hybrid motor propulsion solution utilizing a novel bi-axial grain design in response to solicitation S4.03 Phase II, Spacecraft Technology for Sample Return Missions. Due to the innovative motor design, the proposed system is significantly shorter than a conventional hybrid motor system but maintains safety, reduced complexity, and storability advantages of hybrid motor systems. The system leverages additive manufacturing for the rocket nozzle and injector system in order to decrease both weight and part count. This innovation is an ideal propulsion technology for a variety of sample return missions from Mars or other bodies with significant gravity wells.

Anticipated Benefits

With the wide variety of NASA objectives for sample return, one clear common thread is that high-performance, reliable propulsion systems for small vehicles will be essential to keeping the missions affordable. Parabilis' proposed bi-axial hybrid propulsion technology addresses this common need and enables mission designers to realize a panoply of new high-value science missions that use low-cost small vehicles. In addition to the sample return missions, a propulsion solution to these challenging problems would also be useful across a range of other demanding propulsion applications where high-performance and compact size are critical. These additional uses include entry, descent, and landing operations, launch vehicle upper stages, kick stages, and spacecraft main engines. Every NASA exploration mission utilizes these components to greater or lesser degree, therefore, advancing the state of the art in sample return propulsion is bound to have payoffs throughout the exploration enterprise. Numerous sample return missions from various bodies are either currently underway or in development, with the trend expected to grow as exploration continues. Hayabusa 2 is an asteroid sample return mission operated by the Japanese space agency and is currently en route to a 2018 rendezvous with asteroid Ryugu. ESA is contemplating its own version of a Mars Sample Return mission in the next decade, possibly including samples from Deimos or Phobos. Russia has similar plans, based on heritage from its prior Deimos attempt using the Grunt spacecraft. China has also announced plans to return a sample from Mars by 2030. China is currently constructing the Chang'e 5 mission to return lunar samples. ESA had also contemplated the MarcoPolo-R asteroid sample return mission in 2014 but ultimately downselected a competing mission, however, the mission's high ranking at the time might lead to a future funding opportunity with the agency. The strong international interest in sample return missions comprises a potential first market equal in size to the NASA market.



Novel Hybrid Propulsion System for Sample Return Missions, Phase II Briefing Chart Image

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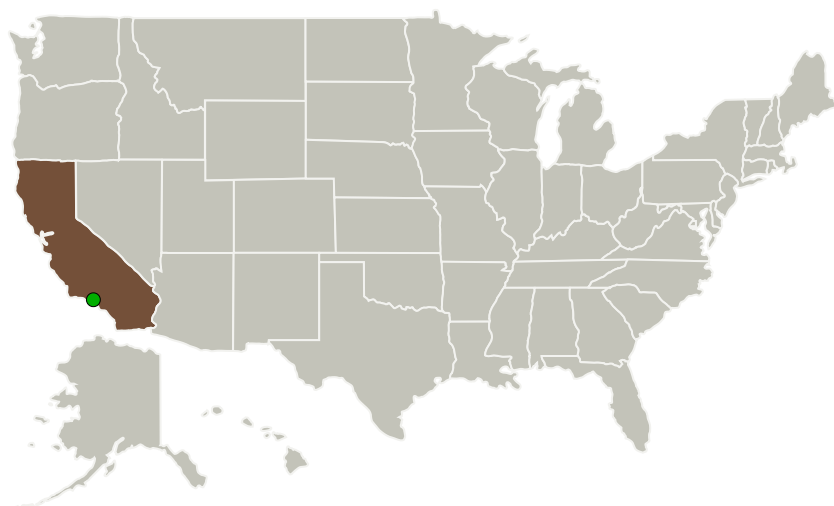
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Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|------------------------------------|-------------------------|--|------------------------|
| Parabilis Space Technologies, Inc. | Lead Organization | Industry Historically Underutilized Business Zones (HUBZones) | SAN MARCOS, California |
| ● Jet Propulsion Laboratory(JPL) | Supporting Organization | NASA Center | Pasadena, California |

Primary U.S. Work Locations

California

Project Transitions

**June 2017:** Project Start**September 2020:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140898>)

TechPort

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<https://techport.nasa.gov/view/93673>

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Parabilis Space Technologies, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:Carol R Lewis
Robert A Jones**Principal Investigator:**

Chris Grainger

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Images



Briefing Chart Image

Novel Hybrid Propulsion System for Sample Return Missions, Phase II

Briefing Chart Image

(<https://techport.nasa.gov/image/132266>)



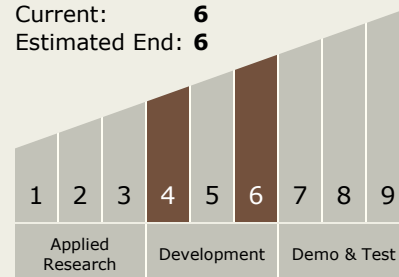
Final Summary Chart Image

Novel Hybrid Propulsion System for Sample Return Missions, Phase II

(<https://techport.nasa.gov/image/131997>)

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System